An Exercise to Remember Important Distributions

While probability (along with its cousin statistics) is perhaps the most applicable area of mathematics, some key building blocks in probability are so essential that they are worth committing to memory. Amongst these building blocks are a few *distributions* that appear all over the place, both in theory and in practice.

The important discrete distributions (or rv's):

- Bernoulli.
- Binomial.
- Geometric.
- Poisson.
- Discrete uniform.

The important continuous distributions (or rv's):

- Uniform (0,1) or, more generally, Uniform(a,b)
- Exponential
- Gaussian (or Normal)

What's important to know about them:

- What is the CDF?
- In the discrete case, what's the PMF. In the continuous case, what's the PDF?
- What are the parameters, if any to each of these, and what do they mean?
- What are the expected value and variance?

Notice the use of terminology (distribution vs rv). We say, for example, that a Bernoulli rv has the Bernoulli distribution. So referring to one implies the other. The rv is the actual variable; the distribution is how probabilities are expressed.

So, in this exercise, you will do something that will undoubtedly feel like tedious "busy work" but that will help cement these for good.

For each distribution above:

- Write out the PMF/PDF and CDF.
- Sketch the PMF/PDF and CDF.
- If the distribution has parameters, what do the parameters mean? In particular, for each parameter: if the parameter has a small value versus large, what is the interpretation?
- Find an example of a small problem that's solved using the distribution and write that out.
- Write out a derivation of the expected value.
- Write out a derivation of the variance.

You can find all of this material readily in books and on websites. The most important thing is to write this out on paper yourself (no typesetting) so that the act of writing it out helps you remember these super-important distributions in the future. Pedagogical research is clear about the effect: the research

shows that personal note-taking significantly improves retention. Thus, the more conscientiously you do this, the better for you in the future.

What to submit:

- A single PDF that's a scan of the pages you wrote.
- Include this in the zip for Assignment 4.
